**US Army Corps
of Engineers**
Waterways Experiment
Station

Improvement of Operations and Management Techniques Research Program

The Application of a Decision Support System to U.S. Army Corps of Engineers Civil Works O&M Budget Analysis

by   *Stephen H. Scott*

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Waterways Experiment Station
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Final report

**US Army Corps
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STRUCTURES
LABORATORY

SCALE

800   0   800 m

AREA OF RESERVATION = 2.7 sq km

Contents

Preface

This study was conducted by the Hydraulics Laboratory (HL) of the U.S. Army Engineer Waterways Experiment Station (WES) during the period October 1990 to October 1994. The study was sponsored by the Headquarters, U.S. Army Corps of Engineers (HQUSACE), as a part of the Improvement of Operations and Management Techniques (IOMT) research program, Work Unit 32717, "The Application of Decision Support Systems to O&M Budget Management," managed by HL. HQUSACE Technical Monitors for the IOMT research program were Mr. James Crews, Chief Technical Monitor, and Mr. Robert Daniel.

This report was prepared by Mr. Stephen H. Scott, Estuarine Engineering Branch (EEB), Estuaries Division (ED), HL. Principal investigators for the work unit were Mr. Scott and Mr. Michael R. Walsh of the Institute of Water Resources (IWR). Technical assistance was provided by Ms. Connie L. Raaymakers and Mr. Edward J. Japel of the Construction Engineering Research Laboratory (CERL). Contractor support was provided by Mr. Craig A. Strus and Mr. Russ E. Robinson of Planning and Management Consultants, Limited, and Mr. Richard M. Males of RMM Technical Services. The development and testing of the prototype decision support software was done with the cooperation of Mr. Dave Harmon of HQUSACE and Mr. Rod Plybon of the Ohio River Division, U.S. Army Corps of Engineers.

The study was conducted under the general supervision of Mr. Frank A. Herrmann, Jr., Director, HL; and Mr. Richard A. Sager, Assistant Director, HL; and under the direct supervision of Mr. William H. McAnally, Jr., Chief, ED, and W.D. Martin, Chief, EEB. Mr. Robert F. Athow, ED, was the IOMT Program Manager.

The research team gratefully acknowledges the contributions of Messrs. Harmon and Plybon, and Ms. Mary Supple and Mr. Jack Sirak of ORD during the development and testing of the Decision Support System (DSS) prototype.

At the time of publication of this report, Director of WES was Dr. Robert W. Whalin. Commander was COL Bruce K. Howard, EN.

For further information on this report or on the Improvement of Operations and Management Research Program, please contact Mr. Robert F. Athow, Program Manager, at (601) 634-2135.

1 Introduction

Background

The goal of this Improvement of Operations and Management Techniques (IOMT) work unit was to provide decision support tools for increasing the efficiency and productivity of Civil Works O&M project managers. The Corps of Engineers Civil Works O&M budget totals approximately $1.4 billion dollars yearly. This budget supports 700 major Corps of Engineers constructed projects such as locks, dams, and power plants, as well as many other projects that require O&M funding for continued operation. The Civil Works budgeting process is a cooperative effort between the Corps of Engineers Districts, Divisions, and Headquarters, U.S. Army Corps of Engineers (HQUSACE). Budget packages are developed for individual projects at the field level (District and Division) on a personal computer based system (Automated Budget System (ABS)) and uploaded to HQUSACE for final budget development on a mainframe computer. The O&M budget contains approximately 20,000 work functions[1] for funding consideration. These budget submissions must fall within a funding ceiling provided by the Office of Management and Budget (OMB) for the O&M General appropriations account. Work functions are prioritized for funding based on funding guidance set in a funding matrix provided by HQUSACE. During this ranking process, critical funding decisions must be made on funds allocation. Project benefits must be evaluated in terms of providing service to the public as well as providing a suitable economic return on O&M dollars invested.

Analytical tools for ranking work functions and determining funding impact scenarios at HQUSACE were limited. The budget packages were submitted to HQUSACE for final budget preparation on a mainframe computer database. Based on the budget submissions from the field, HQUSACE creates a work function ranking independent of the District and Division ranks. This ranking results from numerous funding scenarios investigated by HQUSACE. Report

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[1] The smallest element of work represented in the O&M budget is a work function. It corresponds to a feature cost code or category code. For example, a work function may be the maintenance of a dam. This work function would consist of numerous tasks such as grass cutting, dam maintenance, or outlet works maintenance. It would fall under the feature cost code 621.11 for cost accounting purposes.

generation and analysis to support the HQUSACE work function ranking were performed using the Structured Query Language (SQL) resident on the mainframe database. This method of analyzing and restructuring the budget was time consuming, limited in capability, and costly.

The Decision Support System (DSS) concept is based on the use of a personal computer operating with relational database software to assist in analyzing data and supporting the decision making process. A DSS typically consists of a computer for providing the storage capacity and speed of operation for analyzing large volumes of data in a relatively short period of time and a relational database for providing versatile analysis capability with a user interface menu for choosing analysis options.

This report describes the concept, design, and application of a DSS for assisting in the Civil Works O&M budget development at the HQUSACE and Division level of the Corps of Engineers. The DSS design was created through an iterative design process, including a needs assessment phase, a prototype test and evaluation phase, and field trials.

Objective

The overall objective of this work was to develop decision support capability within the O&M budget process for assisting operations and programming managers in determining criteria by which projects can be evaluated for funds allocation within the budget process. The project approach was threefold:

a. Determine where the development of a DSS would be most beneficial within the budget process through a needs assessment survey.

b. Develop a working prototype through an iterative test and evaluation process, working closely with the potential system user.

c. Implement a fully operational DSS within an actual budget generation process and evaluate its effectiveness.

Approach

This work was originally directed to support operations managers at HQUSACE. During the needs assessment phase of the work, it was determined that enhanced data analysis tools were needed at the HQUSACE level to assist in evaluating the budget packages uploaded from the field offices.

Interviews were conducted with key personnel in the Operations, Construction, and Readiness Division, HQUSACE, to determine how the budget process was structured at the Headquarters level, and what types of analysis tools

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were needed. Interviews were held with supervisory staff (the Assistant Chief of the Operations, Construction, and Readiness Division, and Chief of the Operations Branch) to determine what factors, both external and internal, influence budget construction and data analysis needs. This provided information on how the budget process works at the national level, i.e., the funding constraints of the Presidential Budget and the influence of the OMB in the process of deciding how the funding will be allocated. It was revealed that the immediate need was for a more efficient method of evaluating funding scenarios based on "what if" situations posed by budget analysts or OMB. In the past, these scenarios were generated on the mainframe database, using the database SQL. This method was time consuming and tedious; thus the number of scenario analyses possible within the budget formation time constraints were limited.

Additional needs included a better method to rank work functions for funding, and to provide a financial reporting capability to show the breakout of funds given a funding scenario. Based on the results of the needs assessment, a prototype DSS was designed around a personal computer and commercial database software. A design team was organized with input from three USACE organizations and consultants from industry. The HQUSACE DSS was developed and tested during the Fiscal Year (FY) 1994 budget cycle. Based on the promising results obtained from the prototype tests, a Division level DSS was designed and implemented at the Ohio River Division, USACE, for the FY95 budget cycle. The Division level system was also conceptualized, designed, and tested in an iterative fashion, much like the HQUSACE application.

2 Civil Works O&M Budget Process

The objective of the O&M program is to operate and maintain a large inventory of navigation, flood control, and multipurpose projects as long as they remain economically justified within budgetary constraints and consistent with current national priorities.

The yearly budget for Civil Works project O&M is developed through the ABS and administered by HQUSACE. The guidance for budget development and submission is provided by an annual Civil Works budget Engineer Circular (EC) 11-2-157 (Headquarters, U.S. Army Corps of Engineers 1990), which is updated yearly. This publication provides guidance for funding all operation and maintenance activities under the appropriation titles O&M General, Flood Control, and Mississippi River and Tributaries for the budget fiscal year.

HQUSACE provides a target level of funding for each Division on the basis of a ceiling provided by OMB for the O&M General appropriations account. This is the target funding level that each Division must meet in their budget request. HQUSACE provides a matrix table that describes the level of funding required for each work function category considered. Generally, five levels of funding are available for each work function category. These levels correspond to funding priorities ranging from routine and ordinary maintenance to meet state or federal mission and standards (level 1) to levels which are for additions and betterments in the outyears beyond the budget year. The baseline funding provided by the Presidential Budget is equivalent to level 2 funding. Level 3 funding is considered the O&M effort consistent with normal and customary operation of project features at a cost approximately that of the previous budget year. Levels 4 and 5 funding are the first and second enhancement levels beyond the current level and provide for additions and betterments to enhance project facilities and to meet their demands and full authorized purposes.

The budget process is a transitory process which undergoes alterations from year to year. The above description of how the budget is generally constructed was for the budget year when this study was conducted (FY93 budget year). Changes to the budget are documented in updated EC 11-2-157.

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Automated Budget System Design

The task of managing O&M budget information such as work packages is aided by the ABS, a micro-computer based data management system. This system is used at the Division and District levels to collect, edit, prepare reports from, and otherwise manage, the budget work package data. The ABS was developed by the U.S. Army Construction Engineering Research Laboratory (CERL). This system consists of a database residing on a mainframe computer which is accessed by all of the Corps of Engineer field offices for budget preparation. The District and Division budget database are developed through the use of the ABS, and uploaded to HQUSACE for final preparation. Work functions are grouped or ranked according to criticality first by the District offices and then reviewed and re-ranked by the Division offices before being uploaded to HQUSACE for final ranking. The budget programmers access the mainframe database to run standard budget reports, rank the work functions, and perform limited budget analysis through the database SQL. A more specific description of the ABS is available from the ABS manuals for the District and Division offices and EC 11-8-2 describing budget submission requirements (Construction Engineering Research Laboratory, No. I; Construction Engineering Research Laboratory, No. II; Headquarters, U.S. Army Corps of Engineers 1991).

District Budget Procedures

The Corps of Engineer District offices prepare work packages for their O&M projects through the ABS. They use the guidance provided in the budget circulars for determining the funding level of the work categories and subsequent work functions within the categories. The goal of the District effort is to budget the funds to properly operate and maintain the projects for the budget year, and rank the projects on a priority basis.

Division managers review the previous year's O&M funding request and begin assembling work packages for execution 2 years beyond the current budget year. The data call is extended to the project site level to provide the necessary data for constructing the work packages. A combined listing of the work packages is then put together, and a review process begins. Representatives from the functional divisions of the District, i.e., engineering, planning, etc., review the work packages and rank the work packages for funding.

At the District level, work function rankings are based on the projected adverse impact on the project if complete funding is not available. The criteria considered in the ranking process are customer service, reasonable user needs, minor and ordinary repairs, increased maintenance to ensure adequacy and integrity of structures, public safety, impact on the economy, environmental concerns, and national security. When the District budget is approved, it is uploaded through the ABS to the Division for approval.

Division Budget Procedures

The uploaded District database work packages are then reviewed by programming, operations, and representatives from supporting elements within the Division. The review committee consists of individuals representing the various types of O&M projects: navigation, hydropower, recreation, and flood control. These individuals have the experience and expertise to provide insight into the O&M needs of the projects, and, subsequently, the funding levels required to maintain a high level of project operation. Prior years' funding is taken into consideration, as well as future project requirements, when reviewing the work packages. The Division reviews the project rankings provided by the Districts. Consideration must be given to the work function rankings from all of the Districts before assigning a Division ranking. The Division not only evaluates the District rankings on similar criteria as the District, but also in a broader sense, with consideration given to the impact of project funding on the region as well. Because of this broader view of project/work function priorities, the Division and District rankings frequently differ. After the Division committee reviews the work packages, their questions and recommendations are relayed back to the District. The District then addresses the concerns of the Division and makes revised corrections to the District database for up-load to HQUSACE. The Division database is then established, and Division ranks assigned to work functions on a priority basis are uploaded through the ABS to HQUSACE. Any work function corrections made after formation of the Division database are a Division responsibility.

HQUSACE Budget Procedures

HQUSACE is responsible for reviewing budget submissions from 11 Divisions consisting of a total of 33 Districts. Approximately 20,000 work functions must be reviewed and given a final rank for funding. These ranks must consider the same criteria as the Division and District ranks, but at the national level. Certain projects at the District/Division level will have a greater impact nationally than others. For example, dredging on the Mississippi River is essential for keeping the river channel navigable for the transport of cargo from a significant portion of the United States. It is essential to the national economy that the river remain open. On the other hand, a localized District administered project may be a high priority to the adjacent area or region, but not critical to national interests, and not be as high a funding priority at the HQUSACE level. Therefore the rankings at the District, Division, and HQUSACE levels will often be dramatically different.

3 O&M Budget Analysis Needs

The task of managing the O&M budget information is aided by the use of the ABS. While the ABS functions adequately in assimilating budget data at the field level, it is limited in providing decision support capability. The current structure of the ABS data, the limitations of the network model, and the lack of analytical tools within the existing database management system make it difficult to make queries, cross-tabulations, and other statistical analyses that are needed to make decisions concerning the budget. The ABS does not provide the tools that can assist managers in investigating project options and alternatives. There is no ability to quickly generate "what-if" options to examine the consequences of different work function rankings or cutoff funding levels. Another deficiency of the ABS database is the loss of information as budgeting decisions are made throughout the budget generation process in the field. As the decision level proceeds up the hierarchy, much of the knowledge about what went into the professional judgment at each lower level is lost.

A variety of database analysis capabilities are needed at all levels of Civil Works O&M to support the budget process. Database flexibility is required for performing data manipulations to support budget generation activities such as project rank compilation, funding scenario analyses, and financial analyses.

Interviews were held with personnel of the Operations, Construction, and Readiness Division, HQUSACE, to identify potential DSS applications for supporting the O&M budget process. A major concern of O&M managers was the ability of budget analysts to evaluate all of the budget data and rank the numerous work functions within the time allotted for budget development. The field offices upload the budget packages via the ABS using a mainframe database. During past budget development efforts, budget analysts at HQUSACE accessed the database and performed database operations while connected to the mainframe. The process in which the data were evaluated, and work functions eventually ranked, was tedious and time consuming as well as expensive due to the mainframe computer operation cost. The only analysis tool available to the budget analyst for sorting the database and producing reports was the SQL available on the mainframe database.

It is essential that all alternative funding scenarios be examined before final work function ranks are assigned. Of particular importance are funding scenarios which involve work functions that may be within the vicinity of the funding cutoff line. It is critical that HQUSACE evaluate work functions at this level to ensure that all O&M objectives are optimized.

A scenario, as defined by the budget application, is a data evaluation involving one or more work functions. For example, it may be necessary to query the database for the highest cost dredging work function in the Lower Mississippi Valley Division (LMVD). The desired result might be a report showing the work function name, the funding level, the District that it resides in, and the total dollars. A scenario involving numerous work functions may be a query for all of the level 2 work functions with a cost greater than $1 million. The report generated would list the work functions by Division, District, and the total dollars. Another potential work function ranking scenario may be the effect of a reduction of funds on the ranking of projects around the cutoff line, i.e., which projects would be funded, which would not be funded, and what does the new rank look like. For example, if a class of projects, such as low use recreational areas, are cut from the budget, a data report may be desired that describes what previously funded projects will be cut, in which Divisions and Districts they reside, what the total costs are, and what the new rank looks like after the projects are taken out. These are just a few examples of the numerous analysis options that HQUSACE requires for evaluating the budget. Essentially, HQUSACE had three initial main requirements for the development of a budget analysis DSS: (a) the system must be capable of operating independent of the mainframe computer but capable of communication with the mainframe, (b) the system must be capable of generating and storing scenarios through a menu driven interface, and (c) the DSS must be capable of producing the analysis and subsequent reports with a reasonable process time.

In response to the needs of HQUSACE for enhanced budget analysis capability, a DSS design team consisting of members from U.S. Army Engineer Waterways Experiment Station (WES), CERL, Institute of Water Resources (IWR), and industry consultants developed a prototype budget DSS. The prototype was developed in an iterative test and evaluation process in a cooperative effort with budget analysts from HQUSACE.

4 Budget DSS Prototype Design, HQUSACE Level

In the initial developmental phase, the system software and hardware requirements were determined. The DSS, now named the Corps of Engineers Operations and Maintenance Budget Decision Support System (COMB_DSS), was designed for a 386 personal computer or better, using the DOS operating system. The COMB_DSS prototype was built around a commercially available database, R:BASE, and custom software written in C programming language.

Based on the needs assessment phase of the project, three primary capabilities were built into the prototype DSS: a scenario analyst for creating funding scenarios, a financial analyst for breaking out the costs associated with a scenario, and a rank generator for ranking work functions.

The key database table in the COMB_DSS is the work function table which contains information on each of the individual work functions, including District, Division, Civil Works Investigation Studies (CWIS) number, District and Division rank, initial HQUSACE rank, work function descriptions, project class, and feature cost code. This table is downloaded from the mainframe database into the COMB_DSS. Information in this table is not permanently changed until the final assignment of revised ranks by HQUSACE.

Scenario Analyst

Three types of scenario analyses were designed. A *primary* scenario is the selection of work functions by relating them to a defined set of criteria, for example, all work functions in level 2 funding with funding requirements greater that $1 million. A *composite* scenario relates the work functions contained in multiple primary scenarios. This option would be used to determine which work functions are common to two or more separate primary scenarios. An *SQL* scenario is generated using the database SQL to generate a user-defined query to the work function table to create a scenario. The capability for building the first two scenarios (primary and composite) are

provided from a menu-oriented user interface. The SQL is a manual method of querying the work function table in the database.

The COMB_DSS contains a menu-driven user interface for choosing or building scenarios. The main menu for the COMB_DSS contains the scenario analysis options available. A manage scenarios menu is provided for entering, editing, copying, deleting and renaming scenarios. A run scenarios menu is used for actually building, executing, and evaluating the scenario. Appendix A contains an example of the scenario analysis capability of the COMB_DSS.

Financial Analyst

The financial analyst was designed to provide work function cost breakouts at three levels: at the overall scenario level (Corps wide), detailed costs within a division, and by work function within a scenario. The first two levels allow for comparison of up to seven scenarios, with cost breakouts by Division, Feature Cost Code, and by Project Class. This was designed to provide information on the distribution of costs due to potential funding impacts.

Rank Generator

In the past, work function ranking at the HQUSACE level was performed by assigning ranks to work functions based on evaluations by budget personnel of the District and Division ranks. The ranking approach taken by the COMB_DSS prototype was to priority rank the work functions at the scenario level. Funding scenarios were ranked in order of importance. The scenario rank therefore indicates the ranking priority of the work functions that are included within it. If a work function is in more than one scenario, it is assigned the rank of the highest ranked scenario that it is in.

5 DSS Prototype Test and Evaluation, HQUSACE Level

Overall, six prototypes were developed and evaluated in a cooperative effort with budget analysts at HQUSACE. The final prototype was applied to the FY94 budget year analysis beginning July 1992. The COMB_DSS resided on a 486/50 Mhz computer. The personal computer communication with the mainframe database was accomplished by the Transmission Control Protocol/Internet Protocol (TCP/IP) inherent in File Transfer Protocol (FTP) version 2.0.5. The Civil Works O&M budget database residing on the mainframe computer was accessed and extracted using the RAMIS relational database management system. The size of the budget database resident on the mainframe computer was approximately 22 MB.

The results of the COMB_DSS implementation at HQUSACE were positive. Approximately three times as many funding scenarios were performed as in previous years, without the additional cost of the mainframe computer time. The transmission of data from the mainframe computer to and from the personal computer went smoothly, without causing any substantial delays. The COMB_DSS provided a more cost effective alternative to the manual queries used previously to generate scenarios on the mainframe. More information on the HQUSACE DSS development can be found in Strus et al. (1994).

6 DSS Prototype Design, Division Level

Due to the success of the HQUSACE prototype, it was decided by the development team and HQUSACE to implement a version of the COMB_DSS at the Division level to provide enhanced budget data analysis/decision capability. The Ohio River Division (ORD) was chosen for the design and implementation of the Division DSS, now referred to as the COMB_DSS_D. ORD has responsibility for the administration of projects within four Districts-- Louisville, Pittsburgh, Nashville, and Huntington. Approximately 3600 work functions are submitted in the O&M budget for the districts.

Because the budget submittal and analysis process is somewhat similar for HQUSACE and the Division, the COMB_DSS served as a first prototype, to be altered based on Division needs. The same conceptual approach was taken for the Division application. Interviews were conducted with key Budget personnel within the ORD Construction Operations and Readiness Division. Six desired system capabilities were identified during the interviews: (a) report generation, (b) quality assurance checks, (c) scenario analyses, (d) division ranking, (e) impact analyses, and (f) data transfer to and from the ABS.

Report Generator

The capability to generate custom standard reports was incorporated into the system. In the past, the Division had used a combination of spreadsheet and database software to produce the reports. The COMB_DSS_D utilized a selection criteria data entry form to choose the type of report desired. The reports could be chosen based on the following set of criteria: division rank ranges, funding level, feature cost code ranges, work function count, and appropriation code.

Quality Assurance Checks

This system capability was developed for checking all of the data records

under the work functions to ensure the data were valid. For example, the system checks for missing data such as CWIS numbers, ranks, category codes, or feature cost codes. The Division required this capability during the Division review of the District database.

Scenario and Financial Analyst

The scenario and financial analysis capabilities available from the HQUSACE version were incorporated into the Division version.

Division Ranking

The scenario ranking procedure used in the HQUSACE version did not meet the needs at the Division level. ORD automatically ranks the level 1 work functions, and then manually ranks the level 2 work functions through waivers in a meeting with District and Division personnel. Each work function is evaluated and prioritized, and eventually given a Division rank. With the additional analysis capabilities provided by the COMB_DSS_D, additional capability was added for prioritizing the work function rank. A data entry menu allowed the user to enter a Division rank, which brought up a corresponding work function record. The user was then able to edit the record, save it, and enter another Division rank for a new rank assignment. The result was a table with the final work function rankings. Three other ranking options were built into the COMB_DSS_D, but were not used as frequently during the ranking process.

Impact Analyst

ORD was concerned about the effect of funding allocation changes made at the HQUSACE and OMB levels during the budget review process. They indicated that it was difficult to discern the changes made in the Division budget packages, particularly changes in the cost of work functions, or which work functions were changed from a funded to an unfunded status. A limited impact analysis capability was provided by the COMB_DSS_D which allowed the user to compare the total cost, by work function, with the revised cost after the work package had been through the HQUSACE/OMB review. The impact analysis option was not considered a major need, and was not developed beyond this limited capability.

Data Transfers

Data transfer capability was developed to facilitate the passage of data from the Division ABS to the COMB_DSS_D and to return the data back to the

ABS after analysis. The data transfer process of the budget cycle begins when the Districts upload their work packages to a mainframe computer through the ABS. The Divisions access the mainframe, and download the work packages for review. After the Division reviews the packages and creates a Division database, they are uploaded back to the mainframe, and eventually accessed by HQUSACE. The COMB_DSS_D must download the budget database from the Division personal computer, and return it after analysis. Software was written to read in the ABS database tables and create an output table compatible with the COMB_DSS_D.

7 DSS Prototype Test and Evaluation, Division Level

Three versions of the COMB_DSS_D prototype were developed by the design team with cooperation of ORD budget analysts. The system was tested July 1993 during the budget submittal process for the FY95 O&M budget. The COMB_DSS_D was installed on a 386/25 Mhz personal computer which was connected through a local area network to the mainframe computer located at WES where the ABS database resides.

The Division initially used the quality control component of the COMB_DSS_D to ensure the work function data fields were correct. The system worked as designed, performing logical checks of the data fields and indicating when there was a problem with the database.

The scenario analysis tool was used primarily to generate financial reports on subsets of work function data. Four primary scenarios were built, one for each District (Huntington, Louisville, Nashville, and Pittsburgh). These scenarios were used to generate a feature cost code financial report, which provided total dollars by feature cost code and District. Guidance from HQUSACE required that operations was to comprise 75 percent of the funding and maintenance comprise 25 percent. Scenarios were generated for each District based on this limiting criteria. The Division used the scenario results to assess how closely the Districts adhered to the guidance.

The COMB_DSS_D was successfully implemented at the Division. The system capabilities were all used to some degree to assist in the budget data analysis. Personnel responsible for budget preparation worked closely with the design team in both the design and implementation phase. The prototype was frequently modified as needs arose during the data analysis and ranking stages of budget development. More information on the Division DSS application can be found in IWR (1993).

8 Summary

A DSS was developed for assisting in Civil Works O&M budget data analysis. Funding for system development was provided through the IOMT research program, administered by HQUSACE. A design team consisting of members from IWR, WES, and CERL, along with industry consultants, developed prototype systems for application at HQUSACE and the Ohio River Division of the Corps of Engineers.

The system was developed in the following phases: a needs assessment phase where the O&M budget preparation procedures were examined and DSS applications were determined, a conceptualization phase where the prototype structure was first constructed, an iterative design phase where the user evaluated the prototype and suggested system re-design, and a test and evaluation phase where the DSS was implemented and evaluated during an actual budget preparation and review. Both the HQUSACE and Division applications were based on a work function scenario analysis capability which provided the user with a tool for comparing and prioritizing work functions within the O&M budget.

Scenario analysis, financial reporting, and ranking analysis were the three primary uses of the DSS at both levels. The HQUSACE prototype, COMB_DSS, was successfully implemented during the FY94 budget year preparation. Six prototype versions were built following an iterative design and test plan. Budget analysts were able to run three times as many funding scenarios as in previous years, without the additional costs of the mainframe computer previously generated during the scenario analysis.

The Division prototype, COMB_DSS_D, was implemented at the Ohio River Division during the FY95 budget year preparation. This prototype design contained many of the features of the HQUSACE prototype, with additional options added to meet Division needs. Three prototype versions were built in cooperation with ORD budget analysts. During implementation, the COMB_DSS_D proved particularly useful for providing financial work function summaries for the Districts, quality control capability for checking the District database for completeness, and a systematic method for assisting in the ranking of work functions.

9   Conclusions

The successful design and implementation of DSS's within any decision making environment are dependent on a close working relationship between the system designer and potential user. The hardware and software necessary for creating a user-friendly computer-based system are readily available. The developmental problems are mainly due to problem definition and fulfilling user needs. It is imperative that the decision making environment be defined as completely as possible before beginning prototype development and evaluation.

The HQUSACE application provided ideal conditions for the development effort. One user was primarily responsible for supervising the budget data analysis process, and was readily available for consulting with the design team. The user provided a concise definition of what type of analysis tools were needed, how they should be structured within the overall system, and the type of system output required. The needs assessment phase of the HQUSACE application was instrumental in defining the O&M budget process, the analysis needs, and the initial hardware and software design requirements. Previous years' budget data were available for performing system test and evaluation for each prototype design.

The Division DSS prototype development presented more of a challenge to the design team. Although potential users within the Division worked closely with the design team, unlike the HQUSACE application, the users had no predefined need before the development process began. The design team discussed the HQUSACE prototype with the Division, and assisted in defining the analysis tools that might be needed at the Division level.   During the implementation of the DSS within the actual budget process, additional analysis needs became apparent to the user, requiring numerous alterations to the prototype.

Both applications, HQUSACE and Division, were successful in that they proved that the DSS concept can provide additional budget analysis capabilities. Both applications, particularly the Division application, revealed the need for extensive training on the use of the system. Although the DSS concept potentially is a much more efficient way to retrieve and analyze data, it must also be a system that the user is comfortable with and readily understands. A training manual should accompany any DSS tool to ensure

that the user will adapt the system and use it to its fullest capability. At the time of this writing, both the HQUSACE and Division versions are being refined and adapted into the budget process.

10 References

Construction Engineering Research Laboratory. "Automated Budget System Manual - No. I (District)," Champaign, IL.

Construction Engineering Research Laboratory. "Automated Budget System Manual - No. II (Division)," Champaign, IL.

Headquarters, U.S. Army Corps of Engineers. (1990 Mar). "Annual Program and Budget Request for Civil Works Activities, Corps of Engineers, FY 1992," Engineer Circular No. 11-2-157, Washington, DC.

Headquarters, U.S. Army Corps of Engineers. (1991 Mar). "Submission Requirements," Engineer Circular No. 11-8-2, Washington, DC.

Institute of Water Resources. (1993). "Corps of Engineers Operation and Maintenance Budget Decision Support System, Division Prototype (COMB_DSS_D)," IWR Report 93-R-15, Fort Belvoir, VA.

Strus, Craig A., Robinson, Russ E., Males, Richard M., Walsh, Michael R., Raaymakers, Connie L., and Japel, Edward J. (1994). "Corps of Engineers Operations and Maintenance Budget Decision Support System (COMB_DSS): System concept, design, and prototype evaluation," Volumes I and II, Contract Report HL-94-1, prepared for U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

Appendix A
Example of COMB_DSS
Scenario Generation

The COMB_DSS was primarily designed to provide the capability to analyze work function budget data and present it in report form to the user. The O&M budget data for all eleven Divisions are downloaded from the mainframe computer to the DSS for analysis on the personal computer. The DSS contains two primary capabilities for analyzing work functions: (a) analysis of work functions according to the funding rank and (b) cost analysis of work functions according to Division, Project Class, Project, and Feature Cost Code (FCCD). The analysis capabilities are presented through a menu which presents the analysis options to the user in a direct step-by-step manner.

Operating Menus

Two main menus are used to create and execute the work function analysis options. The "manage" scenarios menu is used to create or edit a work function scenario, and the "run" scenarios menu is used to execute and evaluate the scenario. The menus are designed to take the user through each step of building, editing, executing, and evaluating the work function scenario. Attachment 1 is an outline of the steps necessary for entering, executing and evaluating a work function scenario. Attachment 1a shows the options available under the Manage and Run Scenarios menus. Attachment 1b shows how to build a scenario using the enter/edit/clone primary scenario option on the Manage Scenario menu. The data input tables appear on the bottom. Attachment 1c shows how to compile and run a scenario from the Run Scenario menu.

Work Function Analysis by Rank

Each work function in the database contains an HQUSACE funding rank. In the database, these rankings are depicted in a seven-digit format. For

A1

example, a funding level 1 ranking is shown as 1000520, with the "1" representing the funding level, and the work function rank being 520. The level 2 work functions are specified as 2000000, the level 3 as 3000000, and so on. The following examples will show the utility of the DSS in analyzing the work function data.

Example 1: Analysis of all Level 1 work functions

To analyze the Level 1 work functions, data are input from the Manage Scenarios menu. Input data required are: (a) scenario name; (b) appropriation code (O&M General (C), Construction General (E), or Mississippi River and Tributaries (F)); (c) the range of HQUSACE ranks; and (d) the desired format of the output report (by Division, FCCD, project class, project, or rank. For the level 1 example the following data are input:

a. Name - level 1

b. Appropriation Code - C (only O&M projects)

c. OCE Ranks - 1000000 - 1999999

d. Desired Output - By Division, Division and FCCD, project class, and Division and project ranking list

To execute the program, the Build Scenario option is chosen from the Run Scenario menu, and the scenario is compiled and evaluated. Attachment 2 is the data input table. Attachment 2a is a summary output report showing examples of Division, Division and FCCD, project class, and a partial ranking list by Division and project.

Example 2: Analysis of Special Recreation User Fee work functions for all Divisions

The Special Recreation User Fee work functions are found under feature cost codes 606.3 and 629.9. Therefore on the input menu, only these feature cost codes are selected for analysis. The following data are input:

a. Name - ALLSURF

b. Appropriation Code - C

c. OCE Ranks - (no input defaults to all work functions)

d. FCCD - 606.3 and 629.9

e. Desired Output - by Division, FCCD, and a project summary

The program is then compiled and evaluated through the Run Scenario menu. Attachment 3 is the data input table. Attachment 3a shows the cost by Division, FCCD, and a partial project summary table.

Example 3: Cut 100M from selected operations accounts from the baseline request

The baseline request consists of funding levels 1 and 2. For this analysis, the following data must be specified: OCE ranks, a cumulative dollar amount (100M) to delete above the baseline rank, and the operations feature cost codes (601 - 619). The following data are input:

a. Name - OPCUT100

b. Appropriation Code - C

c. OCE Ranks - 1000000 - 2800000 (levels 1 through 2)

d. Cumulative Cost - $100,000,000

e. FCCD - 601 through 619

f. Desired Output - Division, FCCD, and project FCCD summary

The program is compiled and evaluated through the Run Scenarios menu. Attachment 4 is the data input table. Attachment 4a shows a partial output by Division, FCCD, and partial project FCCD summary.

USER PATH FOR CREATING AND RUNNING WORK FUNCTION SCENARIOS

MANAGE SCENARIOS MENU:

- Create a scenario (enter in a scenario)

    1. DATA INPUT TABLE

    Specify:

        scenario name
        appropriation code (O&M, CG, MR&T)
        ranking range
        range of costs (if needed)
        division(s) output
        project class(s) output
        project(s) output
        rank output
        FCCD(s) output

RUN SCENARIOS MENU:

- Build a scenario - execute the program

- Evaluate a scenario

    2. INPUT SCENARIO OUTPUT PARAMETERS

        Output by:

            DIVISION - Cost totals by Division
            PROJECT CLASS - Cost totals by project class
            FCCD - Cost totals by FCCD
            DIVISION AND FCCD - FCCD totals by Division
            PROJECT SUMMARY - Project class, project,
                              State, project name, cost
            PROJECT AND FCCD - Project name, FCCD, FCCD
                               description, total cost
            RANKING LIST - By Division, project, OCE

    Determine output device (screen or printer)

    Print report

Attachment 1

Main Menu - COMBDSS Prototype 1.6

(1) Manage Scenarios Menu
(2) Run Scenarios Menu
(3) Edit/Browse/Move Work Functions
(4) Financial Analysis
(5) Ranking Generator/Evaluator
(6) Utilities
(7) Quit to R:base

(1)

Manage Scenarios

(1) Enter/Edit/Clone Primary Scenario
(2) Enter/Edit/Clone Composite Scenario
(3) Enter/Edit/Clone SQL Scenario
(4) Scenario Description Reports Menu
(5) Delete Scenario
(6) Check Scenario Dependencies
(7) Change Scenario Name
(8) Set/Edit Scenario Report Titles

(2)

Run Scenarios

(1) Multi-Scenario Select, Build, Evaluate, Store
(2) Select Scenario
(3) Build Temporary Scenario
(4) Evaluate Temporary Scenario
(5) Store Temporary Scenario
(6) Browse Temporary Scenario
(7) Recall Stored Scenario
(8) Force Cumulative Cost Calculation for Temporary Scenario
(9) Check Status

Attachment 1a

Manage Scenarios
(1) Enter/Edit/Clone Primary Scenario
(2) Enter/Edit/Clone Composite Scenario
(3) Enter/Edit/Clone SQL Scenario
(4) Scenario Description Reports Menu
(5) Delete Scenario
(6) Check Scenario Dependencies
(7) Change Scenario Name
(8) Set/Edit Scenario Report Titles

Enter
Edit
Clone
Quit

Feature Cost Codes

OCE Ranks

CWIS

Scenario

CLASS

DIV

Name	Approp	Low Use Navigation		
		to	OCE Ranks	
		to	Output Measure	
		to	User 1	
		to	User 2	
Min Cost			Cumulative Cost	A/D

Description

Notes
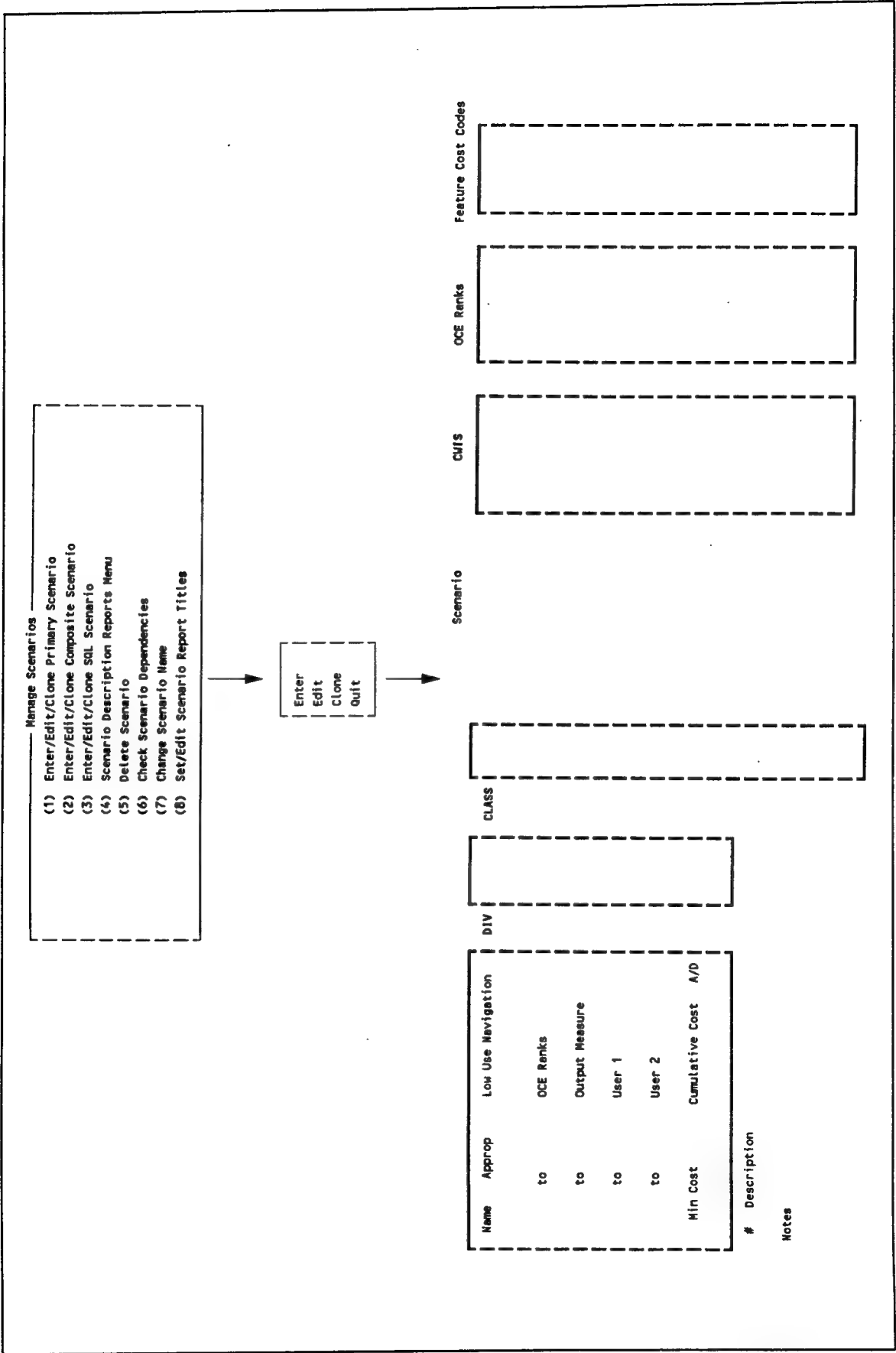
Run Scenarios

- (1) Multi-Scenario Select, Build, Evaluate, Store
- (2) Select Scenario
- (3) Build Temporary Scenario
- (4) Evaluate Temporary Scenario
- (5) Store Temporary Scenario
- (6) Browse Temporary Scenario
- (7) Recall Stored Scenario
- (8) Force Cumulative Cost Calculation for Temporary Scenario
- (9) Check Status

(2)

Choose scenario:

level1	P	1	Level 1 work functions in O&M, General program
WAIVERS	P	2	Division waiver requests
CUMLEV2	P	3	Work functions in funding level 1 and 2
UNFNDNAV	c	4	Waivers not included in initial recommended Budget Scen. 5
LV2BLWDR	c	5	Level 2 plus any level 3 low use navigation dredging
ALLSRUF	P	6	All SRUF work functions in FY 1994 database
SRUFBU0	c	7	SRUF work functions in the initial FY 94 recommended budge
OPCUT100	P	8	$100M Cut of operations from baseline request
CUTBS100	c	9	Division recommend. budget + Maj Rehab - $100M operations
MTWVLWD2	P	10	Selected Maintenance waivers from LMVD - second set
MTWVMRD2	P	11	Selected Maintenance waivers from MRD - second set
MTWVNCD2	P	12	Selected Maintenance waivers from NCD - second set
MTWVNED2	P	13	Selected Maintenance waivers from NED - second set
MTWVNPD2	P	14	Selected Maintenance waivers from NPD - second set
level4	P	15	Level 4 work functions in O&M, General program
level9	P	16	Level 9 work functions in O&M, General program

(3)

PROGRAM COMPILATION

AND EXECUTION

(4)

Choose desired reports:

- Division Name
- Project Class
- Fccd Prefix
- Fccd Full
- Division & FCCD
- Project Summary
- Project FCCD Summary
- Ranking List - Division, Project
- Ranking List - OCE Rank Ascending
- Ranking List - OCE Rank Inverted

Attachment 1c

```
 Name      Approp      Low Use Navigation     DIV            CLASS
 level1      C              -

 1000000 to  1999999  OCE Ranks

 -0-     to  -0-      Output Measure

 -0-     to  -0-      User 1

 -0-     to  -0-      User 2

   Min Cost        Cumulative Cost   A/D
  -0-              -0-               -
```

 #   Description
 1   Level 1 work functions in O&M, General program
 Notes
 Level 1 work functions in O&M, General program

```
Scenario             CWIS          OCE Ranks      Feature Cost Codes

level1
```

```
Temporary Scenario Table      Date:  02/17/93   Time:  16:16:29

Scenario:  level1

Number of Work Functions: 8075

 Total Cost: 1,182,177

  Temporary Scenario Costs By Division

  Scenario: level1          1 P                  Date: 02/17/93  Time: 16:16:34

        Desc: Level 1 work functions in      Notes:  Level 1 work functions in
              O&M, General program                    O&M, General program

                 Total Cost
     Division   (Thou $)
     --------   -----------
       LMD        136,573
       MRD         69,137
       NAD         91,715
       NCD        133,964
       NED         20,366
       NPD        135,140
       ORD        162,527
       POD            130
       SAD        169,518
       SPD         42,826
       SWD        175,171
       ZZ1         45,110

     Total:     1,182,177
```

Attachment 2a
(Sheet 1 of 5)

Temporary Scenario Table   Date: 02/17/93 Time: 17:25:29

Scenario: level1

Number of Work Functions: 8075

Total Cost: 1,182,177

Temporary Scenario Costs By Division and FCCD

Scenario: level1   Date: 02/17/93 Time: 17:25:35

Div	FCCD	Feature Title	Total Cost (Thou $)
LMD			
	01.1	LOCK OPERATIONS	14,353
	01.2	DAM OPERATIONS	3,434
	01.3	RESERVOIR OPERATIONS	410
	02.1	OPERATION OF SERVICE FACILITIES - ROADS AND BRIDG	136
	02.2	OPER. OF SERVICE FACILITIES - BLDGS, GROUNDS & UT	2,402
	02.3	OPERATION OF SERVICE FACILITIES - PERM. OPER. EQU	1,758
	03.1	OPERATION OF LEVEES AND FLOODWALLS	29
	03.2	OPERATION OF PUMPING PLANTS	360
	04	OPERATION OF POWER PLANT	1,769
	05.1	MGMT OF NATURAL RESOURCES EXCLUDING FISH HATCHERI	1,570
	05.4	MGMT OF ARCHAEOLOGICAL & CULTURAL RESOURCES	335
	06.1	MGMT OF RECREATION AREAS & FACILITIES	9,316
	07.11	PROJECT CONDITION SEDIMENT SURVEYS	6,842
	07.12	ENVIRONMENT DREDGING & MONITORING STUDIES	407
	07.21	INSTRUMENTATION	116
	07.22	PERIODIC INSPECTIONS & CONT. EVALUATION DATA GATH	1,189
	07.23	PERIODIC INSPECTIONS	153
	07.24	PERIODIC INSPECTION REPORTING	78
	07.42	DAM FAILURE EMERGENCY PLANNING	7
	07.53	OTHER COND & OPER STUDIES IN SUPPORT OF O&M	60
	09.1	WATER CONTROL MANAGEMENT-DATA COLLECTION&PROCESSI	2,691
	09.2	WATER CONTROL MANAGEMENT-WATER CONTROL ANALYSIS	1,001
	09.3	WATER CONTROL MANAGEMENT-WATER QUALITY	793
	10.11	INSPECTION OF COMPLETED WORKS	560
	11	REAL ESTATE ACTIVITIES - INSPECTIONS, OUTGRANTS,	864
	13	OSHA ACTIVITIES	10
	16	LAW ENFORCEMENT	458
	20	LANDS & DAMAGES	111
	20.7	LANDS & DAMAGES - TIMBER HARVESTS	68
	21.11	DAM MAINTENANCE	117
	21.16	ENVIRONMENTAL COMPLIANCE FOR DAM MAINTENANCE	25
	22.1	LOCK AND SALT WATER CONTROL STRUCTURE MAINTENANCE	4,215
	23.1	SCHEDULED POWER PLANT MAINTENANCE	1,196
	23.2	NON-SCHEDULED POWER PLANT MAINTENANCE	20
	24.1	MAINT. OF NATURAL RESOURCE FACILITIES	84
	25.1	ROAD AND BRIDGE MAINT. - NON-RECREATIONAL	115
	27.1	LEVEE, FLOODWALLS, HURRICANE BARRIERS AND OTHER F	109
	29.1	MAINT. OF RECREATION FACILITIES	405
	29.11	ENVIRONMENTAL COMPLIANCE - RECREATION MAINTENANCE	100
	29.2	ROAD AND BRIDGE MAINT. - RECREATIONAL	470
	29.3	EROSION CONTROL IN RECREATION AREAS	170
	29.4	MAINT. OF VISITOR CENTERS	66
	30.1	PERM OPER EQUIP-WATER CONTROL DATA SYSTEMS EQUIP	19

30.2	MAINT. OF PERM OPER EQUIP-REGULAR	241
31	BANK STABILIZATION	60
32.1	MAINT. OF NON-RECREATIONAL BLDGS, GROUNDS AND UTI	154
33.11	DREDGING -. NAVIGATION	71,298
33.21	NON-DREDGING NAVIG. CHANNEL MAINT., SNAGGING, CLE	1,698
33.22	MAINT. OF REVETMENTS, GROINS OR DIKES TO CONTROL	4,481
33.3	DREDGED MATERIAL DISPOSAL FACILITY CONSTRUCT. AND	250

Temporary Scenario Table   Date: 02/17/93   Time: 16:36:24

Scenario: level1

Number of Work Functions: 8075

 Total Cost: 1,182,177

  Temporary Scenario Costs By Class

  Scenario: level1   Date: 02/17/93 Time: 16:36:30

Proj Class	Class Description	Total Cost (Thousand dollars)
FA		200
FC		9,709
FE		4,000
FI		3,261
FR		213,553
FS		3,216
FX		3,931
MN		106,438
MP		182,950
NA		5
NB		600
NC		365,629
ND		300
NL		228,668
NO		2,100
NR		3,487
NT		335
NU		5,000
NV		1,050
NW		4,247
NX		6,000
PA		1,702
PC		50
PD		575
PN		3,780
PP		8,000
PR		7,724
PS		9,557
PV		1,000
PW		4,310
RP		800
Total:		1,182,177

Lower Mississippi Valley Division

Ocerank	DivRank	Div	Cls	FCCD	TotCost	
						ATCH RIVER & BAYOUS CHENE BOEUF & BLACK
1032090	10834	LMD	NC	07.11	75	PROJECT CONDITION SEDIMENT SURVEYS
						SURVEYS REQUIRED TO REPORT CHANNEL CONDITION TO PROJECT USERS
1032190	10894	LMD	NC	09.1	200	DATA COLL & MAINT FOR WC OR WQ ACTIVITIES
						OPERATIONS ACTIVITIES
1032235	10921	LMD	NC	07.12	50	ENVIRONMENT DREDG STUDIES & MONITOR ACTIVITIES
						CONTINUE ONGOING ENVIRONMENTAL DREDGING STUDIES MONITORING
						ACTIVITIES. WETLAND CATEGORY: CONSERVATION/RESTORATION
1015680	10396	LMD	NC	33.11	2,050	DREDGE BAR CHANNEL
						PROVIDE ACCESS TO FABRICATION SHIPYARDS & PORT OF MORGAN CITY
1024060	10756	LMD	NC	33.11	1,740	BAYOU CHENE, BOEUF AND BLACK
						PROVIDE ACCESS TO FABRICATION SHIPYARDS & PORT OF MORGAN CITY.
						DREDGE BAYOU BOEUF UPPER LIMIT TO Y.
1015685	10399	LMD	NC	33.11	2,025	DREDGE BAY CHANNEL
						PROVIDE ACCESS TO FABRICATION SHIPYARDS & PORT OF MORGAN CITY

                    Project Total   6,140

						BARATARIA BAY WATERWAY
1032195	10897	LMD	NC	09.1	55	WATER QUALITY DATA COLLECTION
						MONITOR CHANGES WHICH MAY AFFECT THE PROJECT ENVIRONMENT
1032120	10852	LMD	NC	07.11	20	PROJECT CONDITION SEDIMENT SURVEYS
						SURVEYS REQUIRED TO REPORT CHANNEL CONDITION TO PROJECT USERS
1012760	10261	LMD	NC	33.11	500	DREDGE BAR CHANNEL & BAYOU RIGAUD
						CC-PROVIDE CONNECTION TO GULF AT GRAND ISLE WITH GIWW AT NEW
						ORLEANS - E&D FOR FY 94 CONTRACT

                    Project Total   575

						BAYOU BODCAU RESERVOIR
1034105	11164	LMD	FR	20.7	3	TIMBER HARVEST
						NECESSARTY TO PROCESS SALE OF TIMBER WHICH WILL PROVIDE GREATER
						THAN COST OF PROCESSING IN BY
1032335	10981	LMD	FR	11	9	MANAGT, COMPL., UTILI., INSPECTIONS, OUTGRANTS & AUDITS
						COMPLIANCE/UTILIZATION INSPECTIONS
1016610	10603	LMD	FR	05.4	6	CULTURAL RESOURCE INVENTORY
						INVENTORY FOR CRITICAL PRIORITY AREAS
1031345	10822	LMD	FR	06.1	101	OPER OF RECREATION AREAS
						OPER & PERFORM MINOR MAINT IN REVENUE PRODUCING AREAS TO MEET ONLY
						BASIC NEEDS OF THE VISITING PUBLIC
1034125	11176	LMD	FR	05.1	20	MANAGEMENT OF NATURAL RESOURCES - FOREST MGT
						PERFORM MINOR & ORDIN MAINT CRITICAL TO PRESERVATION OF NATURAL
						RESOURCES.
1016570	10579	LMD	FR	07.22	15	CONTINUING EVALUATION DATA GATHERING
						ESSENTIAL GATHERING PROCESSING, PLOTTING, EVALUATION,& REPORTING OF
						ENGINEERING MEASUREMENT DATA.
1012840	10309	LMD	FR	02.3	8	OPER OF PERM OPERATING EQUIPMENT
						OPERATE & PERFORM MINOR MAINTENANCE TO PROJECT EQUIPMENT
1009110	10192	LMD	FR	01.2	60	OPERATION OF DAM
						OPER OF DAM & MINOR MAINTENANCE TO ASSURE FLOOD CONTROL CAPABILITY
1009140	10210	LMD	FR	01.3	50	OPERATION OF RESERVOIR
						RESERVOIR MAINTENANCE & SURVEILLANCE TO ASSURE FLOOD CONTROL
						CAPABILITY

```
| Name     Approp      Low Use Navigation  | DIV |       |   | CLASS |       |   |
| ALLSRUF    C               -              |     |       |   |       |       |   |
|                                           |     |       |   |       |       |   |
| -0-    to  -0-     OCE Ranks              |     |       |   |       |       |   |
|                                           |     |       |   |       |       |   |
| -0-    to  -0-     Output Measure         |     |       |   |       |       |   |
|                                           |     |       |   |       |       |   |
| -0-    to  -0-     User 1                 |     |       |   |       |       |   |
|                                           |     |       |   |       |       |   |
| -0-    to  -0-     User 2                 |     |       |   |       |       |   |
|                                           |     |       |   |       |       |   |
|   Min Cost       Cumulative Cost    A/D   |     |       |   |       |       |   |
|   -0-               -0-              -     |     |       |   |       |       |   |
```

Description
6   All SRUF work functions in FY 1994 database
Notes
All Special Recreation User Fee work functions in the FY 1994
database (feature cost codes 06.3 and 29.9

```
Scenario          CWIS          OCE Ranks      Feature Cost Codes

ALLSRUF        |       |      |       |       |  I   06.3  |
               |       |      |       |       |  I   29.9  |
```

```
Temporary Scenario Table      Date:  02/12/93   Time:  15:30:13

Scenario:  allsruf

Number of Work Functions: 220        .

 Total Cost: 17,256

  Temporary Scenario Costs By Division

  Scenario: allsruf        6 P                    Date: 02/12/93  Time: 15:30:13

        Desc: All SRUF work functions in FY   Notes:  All Special Recreation
              1994 database                           User Fee work functions in
                                                      the FY 1994   database (fe
             Total Cost
   Division  (Thou $)
   --------  -----------
     LND         1,700
     MRD         1,500
     NAD           300
     NCD           901
     NED            95
     NPD           433
     ORD         2,581
     SAD         2,500
     SPD           500
     SWD         6,746

   Total:        17,256

  Temporary Scenario Costs By FCCD Prefix

  Scenario: allsruf        Date: 02/12/93  Time: 15:30:14

  FCCD                                          Total Cost
  ----                                          ------------------
  06 RECREATION MANAGEMENT                              2,373
  29 RECREATION FACILITIES                             14,883

  Total:                                               17,256

  Temporary Scenario Costs By FCCD

  Scenario: allsruf        Date: 02/12/93  Time: 15:30:15

                                                Total Cost
  FCCD    Feature Title                         (Thou $)
  ------  --------------                        -----------
  06.3    MGMT OF RECREATION AREAS & FACILITIES USING SRUF      2,373
  29.9    MAINT. OF RECREATION FACILITIES USING SRUF           14,883

  Total:                                               17,256

                                        List of Projects
                                        allsruf      6 P

                                        All SRUF work functions in FY
                                        1994 database
```

Lower Mississippi Valley Division

Cat/ Class/ SubClass	Class	State	Project	Total Cost (Thou $)
210	FLOOD CONTROL - RESERVOIRS			
		IL		
			CARLYLE LAKE IL	200
			LAKE SHELBYVILLE IL	307
			REND LAKE IL	100
		MO		
			WAPPAPELLO LAKE MO	10
Subtotal	FLOOD CONTROL - RESERVOIRS			617
300	MULTIPLE PURPOSE - NON NAVIGATION			
		AR		
			BLAKELY MT DAM-LAKE OUACHITA	400
			NARROWS DAM-LAKE GREESON	433
		MO		
			CLARENCE CANNON DAM & MARK TWAIN LAKE MO	250
Subtotal	MULTIPLE PURPOSE - NON NAVIGATION			1,083
Subtotal	Lower Mississippi Valley Division			1,700

```
| Name      Approp     Low Use Navigation |  DIV |      |  CLASS |      |
| OPCUT100   C             -               |      |      |        |      |
|                                         |      |      |        |      |
| 0      to 2800000  OCE Ranks            |      |      |        |      |
|                                         |      |      |        |      |
| -0-     to -0-     Output Measure       |      |      |        |      |
|                                         |      |      |        |      |
| -0-     to -0-     User 1               |      |      |        |      |
|                                         |      |      |        |      |
| -0-     to -0-     User 2               |      |      |        |      |
|                                         |      |      |        |      |
|   Min Cost        Cumulative Cost   A/D |      |      |        |      |
|   -0-               $100,000.00      d  |      |      |        |      |
```

```
#    Description
8    $100M Cut of operations from baseline request
Notes
Lowest priority operations work functions up to $100M from
baseline request
```

Scenario	CWIS	OCE Ranks	Feature Cost Codes

```
OPCUT100                                        a   01%
                                                a   02%
                                                a   03%
                                                a   04%
                                                a   05%
                                                a   06%
                                                a   07%
                                                a   08%
                                                a   09%
                                                a   1%
```

```
Temporary Scenario Table        Date: 02/17/93   Time: 15:17:01

Scenario:  OPCUT100

Number of Work Functions: 2810

 Total Cost: 99,907

  Temporary Scenario Costs By Division

  Scenario: OPCUT100        8 P              Date: 02/17/93  Time: 15:17:02


        Desc: $100M Cut of operations from    Notes:  Lowest priority operations
              baseline request                        work functions up to $100M
                                                       from baseline request
              Total Cost
   Division   (Thou $)
   --------   ----------
     LMD         6,752
     MRD        13,421
     NAD         3,289
     NCD        13,400
     NED         2,730
     NPD         8,693
     ORD        16,109
     POD           319
     SAD        13,240
     SPD         9,132
     SWD        12,822

   Total:        99,907

  Temporary Scenario Costs By FCCD


   Scenario: OPCUT100            Date: 02/17/93  Time: 15:17:13


                                                       Total Cost
   FCCD    Feature Title                               (Thou $)
   ------  -------------                               ----------
   01.1    LOCK OPERATIONS                                7,773
   01.2    DAM OPERATIONS                                    98
   01.3    RESERVOIR OPERATIONS                             299
   02.1    OPERATION OF SERVICE FACILITIES - ROADS AND BRIDGES   837
   02.2    OPER. OF SERVICE FACILITIES - BLDGS, GROUNDS & UTILITIES  6,712
   02.3    OPERATION OF SERVICE FACILITIES - PERM. OPER. EQUIP.   3,364
   03.1    OPERATION OF LEVEES AND FLOODWALLS                20
   04      OPERATION OF POWER PLANT                         662
   05.1    MGMT OF NATURAL RESOURCES EXCLUDING FISH HATCHERIES  10,336
   05.3    FISH HAULING ACTIVITIES                          322
   05.4    MGMT OF ARCHAEOLOGICAL & CULTURAL RESOURCES    2,119
   05.5    MANAGEMENT OF WILDLIFE MITIGATION FEATURES     1,014
   06.1    MGMT OF RECREATION AREAS & FACILITIES         17,910
   06.2    OPERATION OF VISITOR CENTERS                   4,711
   06.3    MGMT OF RECREATION AREAS & FACILITIES USING SRUF  1,890
   06.4    MASTER PLANNING                                2,663
   07.11   PROJECT CONDITION SEDIMENT SURVEYS             3,532
   07.12   ENVIRONMENT DREDGING  & MONITORING STUDIES     2,406
   07.13   OTHER DREDGING STUDIES                           133
   07.21   INSTRUMENTATION                                  541
   07.22   PERIODIC INSPECTIONS & CONT. EVALUATION DATA GATHERING  2,381
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07.23	PERIODIC INSPECTIONS	1,299
07.24	PERIODIC INSPECTION REPORTING	669
07.41	DAM SAFETY STUDIES	1,435
07.42	DAM FAILURE EMERGENCY PLANNING	422
07.52	ENERGY CONSERVATION PROGRAM	198
07.53	OTHER COND & OPER STUDIES IN SUPPORT OF O&M	4,229
07.6	HYDRAULIC MODEL STUDIES	32
07.7	MAJOR REHABILITATION EVALUATION REPORTS	440
09.1	WATER CONTROL MANAGEMENT-DATA COLLECTION&PROCESSING	1,300
09.2	WATER CONTROL MANAGEMENT-WATER CONTROL ANALYSIS	2,185
09.3	WATER CONTROL MANAGEMENT-WATER QUALITY	1,076
10.11	INSPECTION OF COMPLETED WORKS	4,073
10.22	ENERGY CONSERVATION REPORTS	113
11	REAL ESTATE ACTIVITIES - INSPECTIONS, OUTGRANTS, AUDITS	8,473
12.21	OPERATIONAL PLANS	13
13	OSHA ACTIVITIES	517
14	PREVENTION OF OBSTRUCTIVE & INJURIOUS DEPOSITS	896
16	LAW ENFORCEMENT	2,814

Total: 99,907

$100M Cut of operations from
baseline request

Lowest priority operations work functions up to
$100M from baseline request

Scenario: OPCUT100   8 P   Date: 02/17/93 Time: 15:20:18

Lower Mississippi Valley Division

Project Name	Feature Cost Code	Feature Description	Total Cost (Thou $)
ATCH RIVER & BAYOUS CHENE BOEUF & BLACK			
	07.53	OTHER COND & OPER STUDIES IN SUPPORT OF O&M	10
Subtotal ATCH RIVER & BAYOUS CHENE BOEUF & BLACK			10
BARATARIA BAY WATERWAY			
	07.12	ENVIRONMENT DREDGING & MONITORING STUDIES	30
Subtotal BARATARIA BAY WATERWAY			30
BAYOU BODCAU RESERVOIR			
	05.4	MGMT OF ARCHAEOLOGICAL & CULTURAL RESOURCES	6
	06.1	MGMT OF RECREATION AREAS & FACILITIES	15
	11	REAL ESTATE ACTIVITIES - INSPECTIONS, OUTGRANTS, A	4
Subtotal BAYOU BODCAU RESERVOIR			25
BAYOU TECHE LA			
	07.12	ENVIRONMENT DREDGING & MONITORING STUDIES	10
	07.53	OTHER COND & OPER STUDIES IN SUPPORT OF O&M	10
Subtotal BAYOU TECHE LA			20
BLAKELY MT DAM-LAKE OUACHITA			
	02.1	OPERATION OF SERVICE FACILITIES - ROADS AND BRIDGE	46
	02.2	OPER. OF SERVICE FACILITIES - BLDGS, GROUNDS & UTI	14
	02.3	OPERATION OF SERVICE FACILITIES - PERM. OPER. EQUI	10
	05.1	MGMT OF NATURAL RESOURCES EXCLUDING FISH HATCHERIE	28
	06.1	MGMT OF RECREATION AREAS & FACILITIES	439
	06.2	OPERATION OF VISITOR CENTERS	34
	06.4	MASTER PLANNING	53
	07.22	PERIODIC INSPECTIONS & CONT. EVALUATION DATA GATHE	12
	07.42	DAM FAILURE EMERGENCY PLANNING	12
	11	REAL ESTATE ACTIVITIES - INSPECTIONS, OUTGRANTS, A	46

Attachment 4a
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REPORT DOCUMENTATION PAGE

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The Application of a Decision Support System to U.S. Army Corps of Engineers Civil Works O&M Budget Analysis

5. FUNDING NUMBERS
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6. AUTHOR(S)
Stephen H. Scott

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
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12b. DISTRIBUTION CODE

13. ABSTRACT *(Maximum 200 words)*

This Improvement of Operations and Maintenance Techniques (IOMT) work unit was designed to provide decision-making tools to managers involved in the allocation of funding for the U.S. Army Corps of Engineers (USACE) Civil Works Operations and Maintenance projects. These tools, commonly referred to as Decision Support Systems (DSS), provide users with enhanced analytical capabilities for determining the impacts of funding decisions, as well as financial analysis capability for showing the distribution of funds. The DSS concept used in this research was based on a commercially available database (R:BASE) with custom analysis tools added for flexibility. The budgetary data used by the prototype system was obtained through the Automated Budget System (ABS), an existing Corps information system that contains budget data for all the USACE Operations and Maintenance (O&M) Civil Works projects. This report describes the conception, design, and prototype applications of a DSS developed for providing budget data analysis capabilities at Headquarters, U.S. Army Corps of Engineers (HQUSACE) level and the field level (USACE Division level) of O&M budget development. The report describes the design and capabilities of the budget DSS and the prototype applications at HQUSACE and the Ohio River Division, USACE.

14. SUBJECT TERMS
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